GREENSBORO

PROJECT
AND
ENERGY MANAGEMENT

SUCCESS STORIES

The City of Greensboro is committed to the efficient, cost-effective, and environmentally responsible use of energy throughout its municipal operations. The Division of Project and Energy Management actively seeks opportunities to reduce energy consumption and to minimize the total ownership cost of facilities to the taxpayer. Information contained in this publication describes a project-specific methodology that was followed to implement our program objectives. It is our intention that the dissemination of this information foster additional support and participation in our initiatives.

FIRE STATION 18
5903 BALLINGER ROAD

Background

In the mid-1980s, several annexations in the western part of the City required that fire protection be provided to these newly annexed areas. Until funding for a permanent station was approved, a temporary location, designated Fire Station 18, was acquired at the corner of New Garden and Ballinger Roads. This was a residence that was modified into a station. A separate apparatus bay was constructed adjacent to the existing building.

The 1986 bond issue included funding for fire station construction. More annexation, however, made it necessary to use this funding for Stations 19 and 17. In November 1997, voters approved funding to construct the new Station 18.

Options for locations were studied using the Fire Department's computerized service radius study program. Originally it was thought that a new site location would be better. However, several land studies and negotiations with property owners of sites under consideration indicated that a suitable, low-cost site development property could not be found. After a study was made of the existing site, it was determined that if additional land could be purchased to the west of the site, the entire site would be large enough for a new station and site development, and purchase costs would be less. Negotiations with the adjacent homeowner were successful and the required property was purchased.

Following approval to proceed, PEM solicited proposals for design services in the summer of 1997. An architect, TMA Associates, was selected and began work in October 1997.

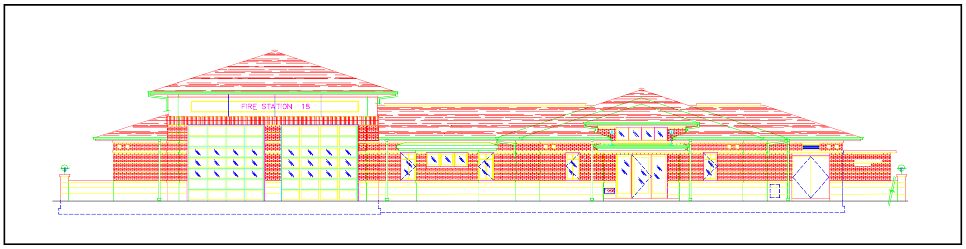
Since the station backs up to a residential area, the neighbors were concerned about the features of the new station based on some incidents during the previous 10 years of the temporary station. During both the Schematic Design and Design Development stages, community meetings were held. Significant citizen input was heard and used in the design. During a last review meeting in November 1998, the citizens stated they were satisfied with the design and efforts made to address their concerns.

Project Objectives

The project objectives committed to providing an energy efficient, sustainable, one company fire station that would provide a means for the Greensboro Fire Department to maintain their reputation as one of the top fire fighting organizations in the nation. The following critical goals were identified early in the Schematic Design process:

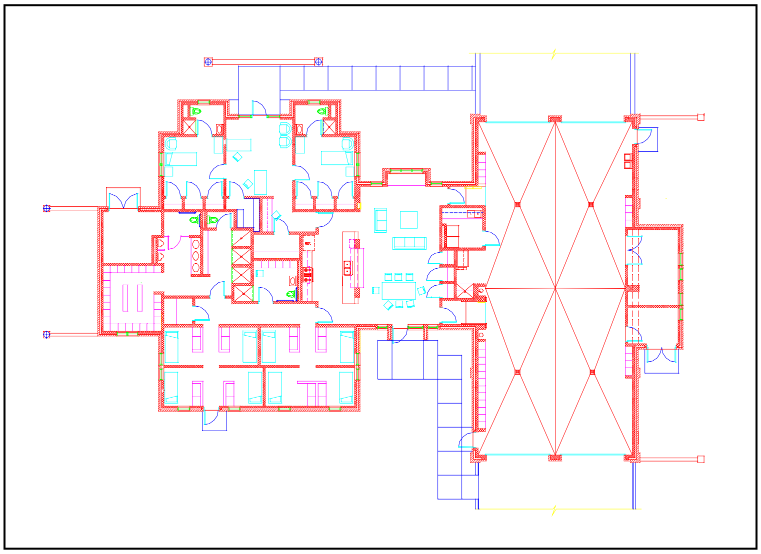
- **Quality**: To provide materials and systems based on overall life cycle costs and maintenance requirements, rather than first costs.
- **Building Function**: To provide fire fighters with an efficient, organized building plan to minimize response time from initial call to truck departure.
- **Site Function**: To integrate the facility into a residential setting by minimizing watershed impacts, ambient noise, visibility, and exterior lighting.
- **Air Quality**: To minimize the impact of rolling stock emissions relative to living areas.
- **Energy**: To minimize energy demand and consumption requirements.
- **Water Conservation**: To minimize water consumption.
- **Sustainability**: To provide a permanent facility that will serve the response zone for 50-60 years.
- **Green Building Design**: To incorporate environmentally sound materials and construction methods that promote use of nontoxic materials, include recycled materials, and stress resource manufacturing efficiency.

Facility Description



Following the goals defined in the project objectives, the project team prepared a 6500 square foot building designed to house a single company of five men with the possibility of temporary staffing of two companies at a total of ten men. Specific aspects of the facility are outlined below.

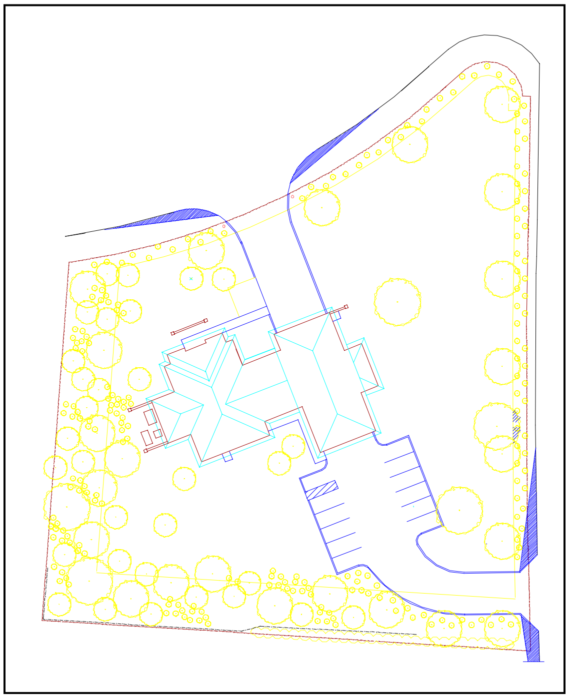
Building Function



The building has been divided into four areas: captains rooms and office, day activities area, sleeping and shower areas, and the apparatus bay. Each area has been configured to provide individual control of lighting and environmental systems, allowing for varied activities to run stand-alone or simultaneously. The flow of circulation has been oriented towards the apparatus bay with the more active areas like the day room and dining areas closest to the apparatus bay, thus allowing for minimal travel distance to the rolling stock.

Site Function

The building site location has been oriented for passive and active solar design collection and optimum location of the apparatus bay to provide the quickest response time in all directions. Site paving has been kept to a minimum and vehicle circulation has been arranged to direct response direction away from residences, thereby addressing noise concerns expressed by surrounding homeowners. The building has been pushed as far north as possible so that landscaping and screening could be provided as a buffer for the residences to the south and west.



Aesthetics

The project team has been successful in designing a traditional building that compliments the surrounding houses in residential scale and material selections. This has been achieved by utilizing low sloped roofs with asphalt shingles and by providing a low, single story profile to match the scale of surrounding houses. The overall height of the building has been kept to a minimum by separating the apparatus bay structure from the living quarters and by providing hip roof transitions with low slope. With the apparatus bay towards the intersection, the tall portion of the building relates more to the neighboring commercial projects and the living quarters relate to the single family homes to the west and south.

Sustainable Building Design

The fire station has been designed to provide a total usable life expectancy of 50-60 years. Material and equipment selection has been based on extended longevity before replacement, ease and time requirements for regular maintenance, ease of operation, expected repair schedules, plus initial and long term green building benefits and costs.

Sustainability Goals

Building Shell	Major Building Service Systems
Foundations, Masonry, Superstructure – Life of building Roofing – 30 years Windows – 20 years Glazing – 20 years Sealants – 10 years	HVAC – 20 years Plumbing Fixtures – 20 years
Interior Building Materials and Finishes	**Furniture, Appliances and Movable Objects**
Terrazzo Flooring – Life of building Quarry Tile Flooring – 30 years Masonry Partitions - Life of building Ceilings – 10 years Painting – 10 years Wood Doors and Hardware – 20 years	Kitchen Appliances – 20 years Built-in Plastic Laminate – 10 years Cabinets and Countertops – 20 years Furniture – 10 years

Green Building Materials

The following is a partial list of materials that have been reviewed during the construction documentation phase and have been specified for use in the project.

Porous Paving	Made from recycled HDPE
Site Drainage Tubes	Made from 70% HDPE
Construction Fencing	Made from 100% recycled polyethylene
Concrete Sealers	Inorganic, mineral, and water-based concrete sealers
Expansion Joint Filler	Made from recycled newsprint containing no formaldehyde
Insect Treatment	Nontoxic wood-boring insect treatment
Toilet Partitions	Solid sheet plastic from HDPE, virgin plastic caps with recycled plastic cores
Mineral Wool Insulation	Made from steel slag with 75% recycled material with R value of 2.97 per inch
Board Insulation	Made without VOCs
Organic Shingles	A 40-year organic asphalt shingle made with recycled paper
Roofing Felt	Organic felt made from asphalt, recycled paper, and recycled wood pulp
Caulk and Putty	Made from cork, damar resin, citrus terpene, coconut oil, and natural latex
Duct Mastic	A low VOC, water-based mastic
Gypsum Wallboard	Contains 30% recycled material
Quarry Tile	Made from recycled in-house waste materials
Precast Terrazzo	Made from recylced materials
Accoustical Ceiling Tile	Made from recycled cellulose, mineral wool, perlite, and clay
Paints	An acrylic latex made without VOCs

Energy Efficiency

The project team has provided an integrated facility design that provides low energy consumption, in many cases exceeding the minimum requirements defined by ASHRAE Standard 90.1. This has been achieved by applying the following features and systems.

Site Orientation

1. The building has been elongated along the east-west axis to maximize passive solar heat gain during winter months.
2. Landscaping has been selected to provide building shading during summer conditions and to allow for solar heat gain during winter months.

Building Envelope

1. Wall sections have been assembled to provide thermal resistance ratings of 0.065 U-value (0.121 is the maximum allowed by Code).
2. Rigid insulation has been provided at all building foundations and below all slab on grade floor sections in the living areas.
3. Windows are double-pane, low-e energy glass having a U-value of 0.34 and shading coefficient of 0.31.
4. Soffits and overhangs have been incorporated into the roof design to reduce summer solar heat gain. Windows have been configured to allow for winter passive solar heat gain.

Plumbing Systems

5. Potable hot water is heated by high efficiency (85%) gas fired equipment.

Mechanical Systems

6. The attic space has thermostatically controlled ventilators to reduce summer heat gain.
7. An air-to-air energy recovery ventilator has been installed on the locker and toilet exhaust systems to pre-condition ventilation air for the air conditioning unit serving the living quarters, allowing for reduced capacity cooling equipment selection, improved humidity control, and improved indoor air quality.
8. The living quarter air conditioning system has been selected with multiple compressors to allow for improved energy efficiency during part load cooling periods.
9. Living quarters are zoned with bypass variable air volume systems.
10. The apparatus bay utilizes multiple, gas fired infrared radiant tube heaters in lieu of forced air heating systems. Combustion air is direct piped to the heaters to prevent infiltration of cold make-up air into the conditioned space.
11. The communications room utilizes a stand-alone ductless split heat pump to provide year round cooling capability, thereby avoiding conflict with the living quarters air conditioning equipment.
12. The living quarters air conditioning unit includes an air side economizer section to provide compressor free cooling during cool periods.

Electrical Systems

13. All lamps are energy efficient T8 and compact flourescent with electronic ballasts.
14. Occupancy sensors are installed in selected areas to automatically shut off lights when areas are inactive.
15. Selected areas have multiple light switching configurations to allow for user selectable lighting levels.
16. The apparatus bay incorporates daylighting controls to automatically dim lighting levels based on ambient lighting levels.

Passive Solar Systems

17. Windows are arranged to provide natural lighting to all areas.
18. Thermal mass of interior materials has been increased to accommodate winter solar heat gain retention.

Active Solar Systems

19. Solar collectors have been incorporated into the potable hot water heating system to minimize gas consumption and to maximize renewable energy sources.
20. Photovoltaic shingles (4 kW array) have been incorporated into the electrical system to minimize the usage of grid power consumption and to maximize renewable energy sources.

Indoor Air Quality

The building design consists of numerous features and systems that focus on providing and maintaining optimum indoor air quality conditions. An emphasis has been placed on exceeding the requirements of ASHRAE Standard 62 without compromising energy consumption. Specific highlights include the following.

21. The living areas are sealed off from the apparatus bay to prevent infiltration of vehicle emission. A positive pressure differential is maintained in the living areas to supplement this capability.
22. A quick disconnect vehicle exhaust system is installed in the apparatus bay to collect emissions from the rolling stock.
23. A carbon monoxide monitor has been installed in the apparatus bay to protect staff from high concentrations of CO gas. Apparatus bay ventilation systems are interfaced to this control to purge the space if required.
24. Windows in living areas can be opened.
25. The air-to-air energy recovery ventilator allows for increased outside air ventilation quantities.

Water Conservation

Due to the concern with available water resources facing the City of Greensboro, the project team has placed increased emphasis on addressing water conservation. Accordingly, the following features have been included.

26. The potable hot water system has recirculating pumps to insure hot water is available on demand at showers and lavoratories.
27. Showers, toilets, and urinals all incorporate low flow features.
28. The dining area dishwasher utilizes an ultra-low wash cycle of only 1.1 gallons per cycle.

Special Features

Various environmental, safety, and technology features have been incorporated into the design of the overall facility, notably:

29. An oil water separator has been installed to prevent rolling stock fluids from entering the sanitary drainage system.
30. A lint trap has been installed in the sanitary drain line to prevent lint and debris from the turnout gear washer from entering the sanitary drainage system.
31. A direct digital control (DDC) system has been installed to provide optimum building automation, energy management, and preventative maintenance functions. This system has been designed to provide ASHRAE Standard 135 BACNET integration capability of level 4 for interface to the City's networked control system.
32. NEBB certified commissioning services have been provided for all plumbing, mechanical, electrical, and solar systems.

Partnerships

Various partners provided services, technology transfer, and resources during the design and construction of this project. Prominent participants include:

1. United States Department of Energy:
   a. Million Solar Roofs.
   b. Rebuild America.
2. United States Environmental Protection Agency:
   a. Energy Star Buildings.
   b. Green Lights.
3. North Carolina Energy Division.
4. North Carolina Solar Center.
5. Public Technology Incorporated.

6. American Society of Heating, Refrigeration, and Air Conditioning Engineers – North Piedmont Chapter.
7. North Carolina A&T State University.

Financing

Text to be developed.

Project Costs

Text to be developed.

Energy Performance

Text to be developed.

Environmental Benefits

Text to be developed.

Contact

For additional information, contact Charles E. Gulledge, III PE
336.373.7760
chuck.gulledge@ci.greensboro.nc.us